

## BACKGROUND OF THE INVENTION

One type of fiber optic connector system includes a first connector mounted on a motherboard that lies in a cabinet, and a second connector mounted on a daughterboard that can be slid into and out of the cabinet. Each connector includes a plurality of optic fiber termini, with pairs of termini of the two connectors mated when their tips abut one another. One problem with this type of system is that it is difficult to clean the termini tips of the connector on the motherboard because it is difficult to remove the motherboard.

When two optic fiber connectors mate, they should approach one another closely enough that their termini tips lie at the middle of the length of an alignment sleeve. However, the connector frames should not directly abut one another. A structure for mounting each connector should halt connector movement towards each other when their termini tips lie properly within the alignment sleeves, but allow the boards on which the connectors are mounted to continue to move towards each other until they are latched in position.

## SUMMARY OF THE INVENTION

In accordance with one embodiment of present invention, a fiber optic connector system is provided which enables easy access to the termini tips of each of the two mating connectors, and which assures a proper depth of insertion of the connector termini while allowing considerable overtravel of boards on which the connectors are mounted. The system includes first and second fiber optic connector assemblies that each includes a connector mounted on a body, each body being mounted on a mounting bracket and slideable thereon, and each mounting bracket fixed to a corresponding daughterboard. A motherboard structure is mounted deep within a cabinet, and each daughterboard is slideable inwardly from an opposite end of the cabinet

towards the motherboard structure. The motherboard structure has at least one hole to allow the connectors to pass through the hole to mate. The motherboard structure has guidepins or guide bores that align the connectors as they approach one another.

5           Each body on which a connector is mounted, has a pair of standoffs that project toward the other standoffs. The connectors continue to approach one another until tips of the standoffs abut one another. When the standoff tips abut, the termini tips of the two connectors lie halfway between opposite ends of the alignment sleeves, and therefore are properly mated. Each  
10       daughterboard can continue to move inwardly until it is latched in position. While a daughterboard and the mounting bracket fixed to the daughterboard continue to move inward, compression springs are compressed and allow the connector and standoffs to not move inward.

15           The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

20           Fig. 1 is an isometric view of a fiber optic connector system of the present invention.

          Fig. 2 is an exploded isometric view of parts of the connector system of Fig. 1.

          Fig. 3 is an exploded isometric view of the first connector of the connector system of Fig. 2.

25           Fig. 4 is an exploded isometric view of the second connector of the connector system of Fig. 2.

          Fig. 5 is an isometric view, taken from the inward end, of the first

connector of the connector system of Fig. 2.

Fig. 6 is a sectional view of the connector system of Fig. 2, showing the connectors separated.

5 Fig. 7 is a sectional view of a portion of Fig. 6, but showing the connectors fully mated.

Fig. 8 is an exploded isometric view of the motherboard structure of the connector system of Fig. 2.

10 Fig. 9 is a partial sectional view showing the termini of two connectors in their proper fully mated positions, and also showing in phantom lines, a position of the first terminus tip in its initial position and a position of the first terminus tip in an extreme inward position.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

15 Fig. 1 illustrates a fiber optic connector system 10 which includes a housing in the form of a cabinet 12, a motherboard structure or motherboard 14 mounted deep within the cabinet on a midplane 16, and first and second daughterboards 20, 22 lying beyond opposite faces of the motherboard. Each daughterboard is slideable in corresponding inward I and outward O directions toward and away from the midplane of the motherboard. The cabinet has slots  
20 24, 26 forming guides that guide the daughterboards in their sliding movement. A pair of latches 30, 32 hold each corresponding daughterboard in its fully inwardly inserted position.

25 Fig. 2 shows that first and second connector assemblies 40, 42 are mounted on corresponding daughterboards 20, 22. Each connector assembly includes a fiber optic connector 44, 46, a body 50, 52 on which the connector is mounted, and a mounting bracket 54, 56 on which the body is slideably mounted. Each mounting bracket is fixed to a corresponding daughterboard 20,

22. Each body can slide in corresponding inward and outward directions I, O on its corresponding mounting bracket. Compression springs 60 urge each corresponding body 50, 52 inwardly with respect to the corresponding daughterboard. As described below, each body can shift position slightly relative to a mounting bracket, in lateral L and longitudinal M directions which are perpendicular to each other and to the inward-outward directions.

A pair of midplane shrouds 70, 72 are mounted on opposite faces of the motherboard 14. Each shroud holds a pair of guidepins 74, 76 that enter corresponding pin-receiving bores 74 formed in the bodies. The guidepins provide initial approximate alignment of the two mating connectors 44, 46. As the daughterboards continue to move inwardly towards their final positions, frames of the connectors 44, 46 engage guide walls of connector-receiving apertures 80, 82, that provide closer alignment of the mating connectors. A variety of motherboard structures can be used, some of which do not even include a board. However, it is desirable that any motherboard structure include guidepins or bore walls for receiving guide pins.

Fig. 6 shows the mounting brackets 54, 56 approaching the shrouds 70, 72 on the motherboard 14. The guidepins 74, 76 have already passed through holes in the bodies 50, 52 and the connectors 44, 46 are approaching each other to mate. During mating, projecting ends 90 of termini 92 of the second connector 46 enter passages 94 of the first connector and abut termini 96 of the first connector 44. At the same time, standoffs 101-104 coupled to the bodies 50, 52 approach each other until tips 106 of corresponding standoffs abut one another.

Fig. 7 shows the connectors moved towards each other until they are fully mated. The termini 92, 96 have abutted one another and the first termini 96 of the first connector have been deflected outwardly O slightly. The tips 106

of the two pairs of standoffs have abutted one another. The daughterboards 20, 22 of Figs. 1 and 2 continue to move towards each other until they are each latched in their fully installed positions. During such final movements of the daughterboards, the bodies 50, 52 shown in Fig. 6 remain stationary, while the mounting brackets 54, 56 which are fixed to the daughterboards, continue moving inwardly or slightly (e.g. 0.1 inch) towards each other. During such slight additional movement, the springs 60 are slightly further compressed (e.g. by 0.1 inch) to allow the mounting brackets to move inward while the connectors 44, 46, standoffs 101, 103 and bodies 50, 52 remain stationary.

The standoffs 101, 102 are parts of posts 110, 112 that extend through holes 114 in the corresponding body and through holes 116 in projections 120 of the mounting bracket. Rear ends 122 of the posts carry clips 124 that may be considered parts of the posts, and that form inwardly-facing shoulders 126 that abut the mounting bracket. The posts have flanges 130 that abut the bodies 50, 52 to prevent inward movement of the bodies and connectors 44, 46 that are mounted on the bodies, when the standoff tips 106 abut one another. However, the mounting brackets 54, 56 can continue to move inward when the standoffs 101, 102 and connectors no longer move inward.

The posts 110, 112 lie loosely in holes 116 of the mounting bracket projections. As a result, the connectors are not closely laterally or longitudinally positioned by the standoffs. However, the connectors are laterally and longitudinally positioned by engagement of the guidepins 74, 76 with bores 114 in the bodies. The connectors 44, 46 can shift laterally and longitudinally only very slightly with respect to the bodies. Walls of the motherboard structure passages 80, 82 help align the connectors 44, 46, and alignment sleeves that surround the termini 92, 94 provide ultimate alignment.

Fig. 9 shows ferrules 160, 162 of two mating termini 92, 94 that lie within an alignment sleeve 164. The tip of one ferrule 160 initially lies at the original position 166A. A ferrule spring 168 biases the ferrule 160 inwardly with respect to the first connector frame 170. The tip is deflected outwardly by the mating ferrule 162. Preferably, the ferrule tip 166A is deflected outwardly (with respect to the first connector frame 170), to the final position shown at 166. If the tip deflects outward of a position 166B, then an insufficient length of ferrule 160 lies within the alignment sleeve 164 to assure good alignment. Thus, the position 166B is the predetermined maximum desirable outward position of first ferrule deflection. Assurance that the tip lies close to the desired position 166, is provided by the tips 106 (Fig. 7) of the standoffs abutting one another. It would be possible to rely upon inward ends 180, 182 of the two connectors abutting one another. However, the ends 180, 182 then would be pressed tightly against one another by the forces of the springs 60 and might create debris from rubbing against one another in an environment subject to vibrations. Such debris can harm the fiber tips. The mating ferrule can be fixed in position in its connector frame or may be spring biased inwardly and be deflectable.

In a connector system that applicant has designed, each of the connectors 44, 46 were of the PHD-Tempus type which is of rectangular cross-section with a width of 0.40 inch and height of 0.36 inch. Each half of the system allows the corresponding connector 44,46 to float axially in  $\pm$  directions by 0.110 inch in either direction, with respect to the mounting bracket, for a total float of  $\pm$  0.220 inch with respect to the mounting brackets.

Figures 3 and 4 show details of each connector assemblies 40, 42. The body 50 of assembly 40 includes two body parts 190, 192. The inner body part

190 has a guideway 194. The mounting bracket 54 has a slide in the form of a tongue 196 that is slideably received in the guideway 194. The tongue 196 is "loosely" received in the guideway 194 to allow the connector 44 to move sideways (in directions L and M) by up to  $\pm 0.010$  inch. Tolerances for the connector 44 in holes 200, 202 in the body, and tolerances for the standoff posts 110, 112 in the body holes 114 are much smaller tolerances (e.g. no more than 0.003 inch) required for assembly. The tongue 196 is wider than the connector 44 and lies between the connector and the daughterboard to provide for stable sliding despite large tolerance in sideward connector shifting. The second connector assembly 42 of Fig. 4 is identical to the first assembly, except for accommodation to mount the second connector 46 in the second body 52 and the construction of the second connector. Applicant notes that the second body 52 includes two body parts 210, 212. The second connector 46 has a frame with connector frame portions 214, 216 that are mounted on the body by being molded integrally with the corresponding second body parts 210, 212.

Thus, the invention provides a fiber optic connector system in which each optical connector is mounted on a board for mating within a cabinet or other housing, but which enables each connector to be easily withdrawn as for cleaning the tips of the optical fiber termini. A motherboard structure lies within the cabinet and provides at least alignment pins or pin-receiving alignment bores, for initial alignment of the two connectors that are to be mated. Each daughterboard carries a connector assembly which includes a mounting bracket fixed to the daughterboard, a body slideable in inward and outward directions on the bracket and biased inwardly, posts with standoffs that abut one another, and a connector on or part of each body. As the connectors mate and their termini tips abut and move within an alignment sleeve, the standoffs

abut and prevent further terminal tip movement towards each other.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art, and consequently, it is intended that the claims be interpreted to cover such modifications and equivalents.

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